

CHARGING FORWARD:

IOWA'S OPPORTUNITIES FOR ELECTRIC
VEHICLE INFRASTRUCTURE SUPPORT

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EXECUTIVE SUMMARY

The Iowa Economic Development Authority (IEDA) was asked to conduct a study on electric vehicle infrastructure pursuant to language in Senate File 2311, 2018 Iowa Acts. The purpose of this study is to investigate the infrastructure support needed for electric vehicles (EVs) (commercial and non-commercial vehicles), evaluate costs and benefits, and make recommendations.

The Iowa Energy Office, housed at IEDA, led the development of this report. The activities that aided in its creation are as follows:

- Organized a steering committee with representation from IEDA, the Iowa Department of Transportation (Iowa DOT) and the utility industry.
- Hosted an EV infrastructure working group meeting to garner input on barriers and solutions. Approximately fifty individuals participated from a diverse mix of companies and organizations including state agencies; utilities; truck stops; convenience and grocery stores; academia; local governments; non-profits; environmental groups; trucking companies; and a national energy association.
- Conducted research of national best practices and emerging issues for EV infrastructure support and development, including building upon IEDA's 2016 study, Advancing Iowa's Electric Vehicle Market.

This report is intended to provide education on charging stations and EVs in Iowa, highlight topics that have been prevalent in stakeholder discussions, and examine related activity in other states. Three strategies have been identified to advance the development of EV infrastructure and help meet the needs of Iowa citizens, businesses and visitors:

- Clarify and update state policies and procedures
- Advance planning and development of charging stations
- Maximize benefits for consumers

Within these strategies, further context is provided and 10 key recommendations provide a path forward for policymakers and stakeholders across Iowa:

- Allow the resale of electricity for vehicle charging
- Enable regulatory oversight of charging stations
- Address electric vehicle related shortfalls to the Road Use Tax Fund
- Improve local codes and permitting
- Support fast charging station feasibility and profitability
- Plan and develop electric charging corridors
- Plan for additional electricity demand
- Incentivize charging at beneficial times
- Enhance consumer access and usage at EV stations
- Electrify transportation choices across Iowa







OVERVIEW OF ELECTRIC VEHICLES AND INFRASTRUCTURE

Electric vehicles and associated charging infrastructure are relatively new to Iowa. Therefore, understanding the basics of the technology provides a helpful foundation to the proceeding discussion about the priority strategies.

Types of Electric Vehicles

There are two designs of electric vehicles:

- Plug-In Hybrid Electric Vehicles (PHEVs) - PHEVs run entirely off of electricity stored in an on-board battery and can also operate solely on liquid fuel. These vehicles can be plugged into an electric power source to charge the battery.
- All-Electric or Battery Electric Vehicles (BEVs) - BEVs use a battery to store the electric energy that exclusively powers the motor. EV batteries are charged by plugging the vehicle into an electric power source.

Most of the electric vehicles on the roads today are light-duty passenger sedans. However, all-electric school buses and transit buses are commercially available today. One Iowa transit system already has plans to operate electric buses. Heavy duty trucks are limited in availability, but several manufacturers are working on new models with anticipated availability by 2020.

Electric Vehicle Numbers

Nationally, electric vehicles became widely available commercially to the mainstream public in late 2010. As of September 2018, the national cumulative sales of all models reached one million. Iowa's share of this market is small but growing. In June 2016, there were an estimated 1,107 registered electric vehicles in Iowa. As of December 30, 2018, the Iowa DOT estimated 3,007 electric vehicles in Iowa, with 1,043 of these representing all electric and 1,964 plug-in hybrid vehicles.¹



Electric Vehicle Charging Infrastructure

Electric vehicles need access to charging stations. In most instances, charging where a vehicle is parked overnight provides most of the power needed for regular trips. Charging stations commonly need a power source, a cord, and a special plug that fits in the port of the vehicle. Inductive charging transfers electricity without a cord at a less efficient rate. This type of charging is in its infancy but is already being used in other countries for mass transit operations.

Charging equipment for EVs is classified by the rate at which the batteries are charged. Charging times vary based on how depleted the battery is, how much energy it holds, the type of battery, and the type of charging equipment. The charging time can range from less than 20 minutes to 20 hours or more, depending on these factors.

All vehicles and all charging stations are not yet fully compatible. Some electric vehicles, primarily plug-in hybrids, cannot plug into a DC fast charging station, due to both the type of port needed on the vehicle and the capability of its battery. Tesla charging stations only accept Tesla vehicles due to the technology configuration, although Tesla vehicles can use an adapter at the other types of stations. All-electric vehicles commonly can take a fast charge, and this is the fastest growing segment of the EV market.

Types of Electric Vehicle Charging

Type of Charging	Level 1 - 110V (~1.4kW)	Level 2 - 220V (~7.2kW)	DC Fast Charger (50 kW and above)	Extreme Fast Charging (350kW and above)
Charging Station 101	Provides same electricity as a regular electrical outlet	More powerful than Level 1; Comprises majority of the stations in U.S.	DC current directly supplied to vehicle; Commonly adds 60-80 miles of range in ~20 minutes	Power output can decrease to match EV battery capacity; Higher power output may be fully realized by EVs within 10 years
Range gained per hour of charge	2-5 miles	10-20 miles	Up to 180 miles	787.5 miles (more than today's EV range)



Fast charging stations are particularly needed along travel corridors to give electric vehicle drivers the confidence to take longer trips. However, the cost to install and operate fast charging stations is significantly higher than that of Level 2 stations and can require utility upgrades to accommodate the level of power needed onsite. With any EV station, the installation costs can vary greatly per location. Factors impacting installation costs include but are not limited to the location and amount of power supply needed, underground obstacles or structures, trenching or boring requirements, construction of concrete pad or building mounting structure and other project and site-specific considerations.

EV Charging Unit Costs

TYPE	COST RANGE
Level 1	\$300 - \$1,500
Level 2	\$400 - \$6,500
DC/Fast Charging	\$10,000 - \$40,000

Based on units available in 2015, does not include installation costs²

Two key types of EV chargers are either networked chargers or stand-alone chargers.

- Networked chargers have oversight and services to support one or more EV chargers. Connection to cellular data or internet is required. Services are available to EV drivers as well as site hosts or network administrators. A network adds a variety of capabilities. For drivers, services may include payment options, real-time station location and availability information, and options such as reservations, messaging and summary reports. Site host services include payment management, customer support, station status, data reporting, and typically access to an online network dashboard.
- Stand-alone or “dumb” chargers do not have network access – they are essentially electrical outlets with circuitry to enable communication and safe charging with the vehicle. Without network access, stand-alone chargers mostly cannot process payments. Stand-alone chargers have lower installation costs, simpler designs, and no recurring fees for features such as payment processing and cloud connectivity. They may also be the only viable option in locations with poor cell reception, or at low-use sites where network fees would likely exceed the cost of allowing free access.

Where And How Electric Vehicles Charge

Home charging often fulfills 80 percent or more of a vehicle’s power needs. Most drivers of EVs charge their vehicles overnight at home using Level 1 or Level 2 charging equipment in their garage or outdoors. However, multi-unit residential complexes often lack available outlets or charging stations. This can limit electric vehicle adoption if the property managers don’t make charging available for interested residents.

Workplace charging can increase the convenience and affordability for electric vehicle drivers when successfully implemented by employers. These locations are often served by Level 2 charging stations and are especially useful for employees with longer commutes or without convenient access to charging at home.

Charging in public places, such as at businesses or public parking garages, helps increase the convenience of having an electric vehicle. Most public charging facilities use Level 2 or fast chargers.

Organizations with fleets of vehicles, such as commercial trucks or school buses, would have unique charging needs. Adoption of electric vehicles in these applications works best with a fixed route or predictable travel patterns and charging infrastructure in their domiciled location like a garage or depot. Heavy duty electric vehicle charging at these locations will require more thorough planning with the utility, due to larger batteries, greater power needs and specific charging time requirements. Some vehicle technologies being developed and tested in other states include vehicle-to-grid applications. This uses the vehicle batteries as energy storage while parked and plugged in, allowing electricity to flow both to the vehicle and back to the grid at different times.

Heavy duty electric vehicle charging will require more thorough planning with utilities, due to larger batteries, greater power needs and specific charging time requirements.

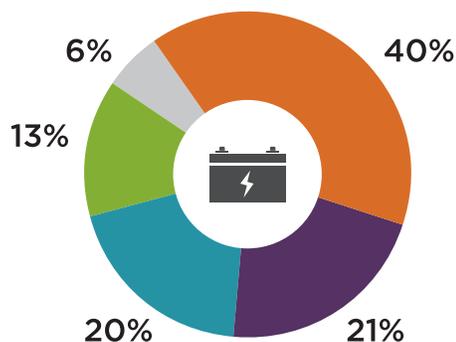


CHARGING STATION DEVELOPMENT

As of December 2018, there were 103 publicly available stations in Iowa, not including Level 1 / wall outlets.³ These stations included a total of 256 plugs, meaning there is more than one spot to plug in at most locations. Eighteen of these stations are exclusively for Tesla vehicles. Some of the stations are intended only for use by guests of their business, but this is still considered publicly available. A breakdown on the types of station hosts is provided in the adjacent pie chart.

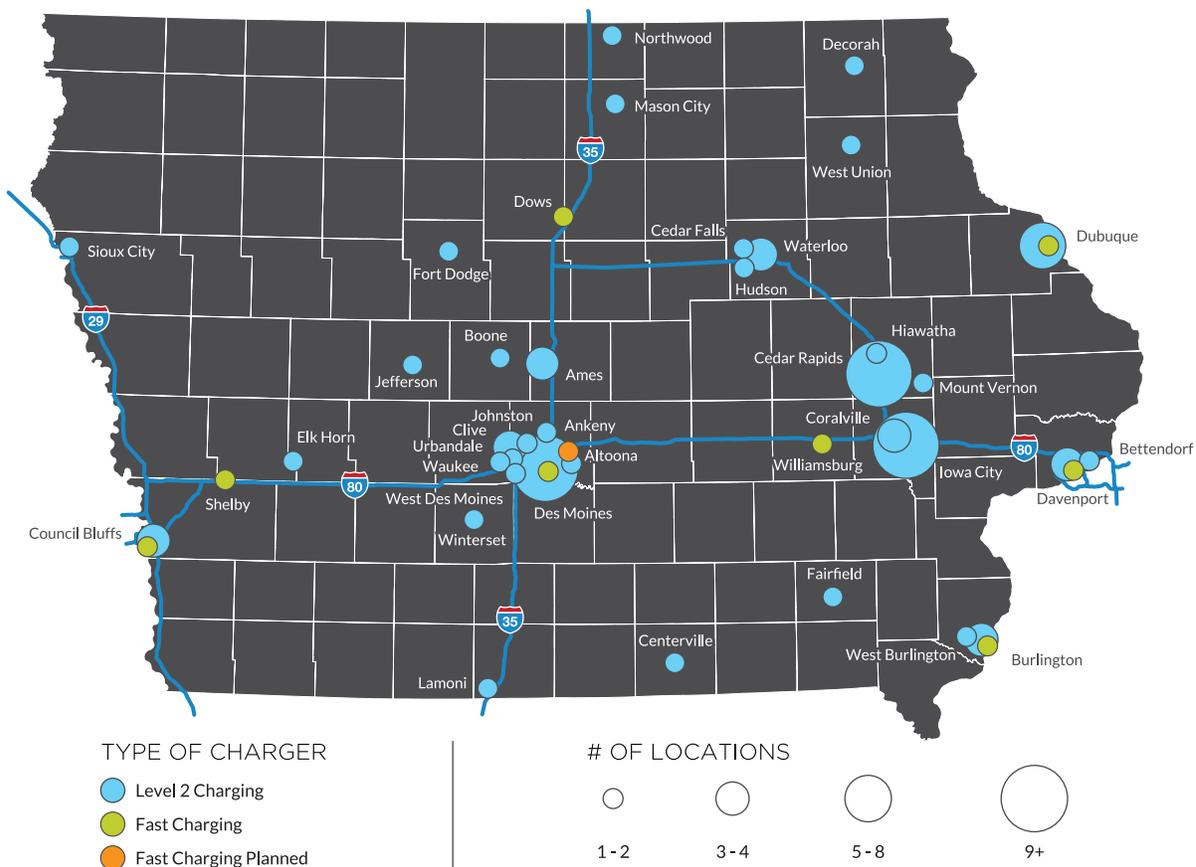
The number of publicly available stations increases on a regular basis and planning for new stations is constantly underway. A significant development in new electric charging infrastructure will be the availability of fast charging stations along Interstate 80 through the investments of Electrify America, a subsidiary of the Volkswagen company. This investment is discussed later in this study. The map below displays the 103 publicly available stations, representing Level 2 and fast charging stations, in addition to fast charging stations by Electrify America and Tesla that are under construction and slated for completion in early 2019.

Types of Station Hosts



- MISCELLANEOUS BUSINESS**
(Grocery, convenience stores, office, casino, restaurant)
- COMMUNITY PARKING**
(Provided by local governments, parking garages, on-street, civic buildings)
- CAR DEALERSHIP**
(Mostly used by customers and on-site EVs)
- HOTEL**
(Both chain hotels and locally owned hotels)
- OTHER**
(Colleges, universities, airport, National Guard)

EV Charging Stations in Iowa



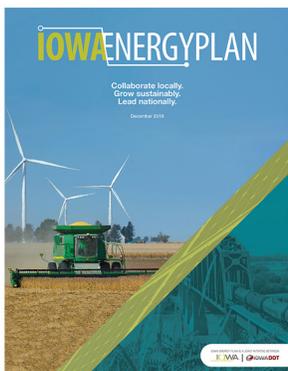


STATE GOVERNMENT CONNECTIONS

The Iowa Energy Office, housed at the Iowa Economic Development Authority, has either led, been involved in or closely monitored state activities on electric vehicles. The Iowa Energy Office is designated by the U.S. Department of Energy (DOE) as the State Energy Office and also manages the Iowa Clean Cities Coalition. The Clean Cities program is part of a national network that works with DOE and stakeholders to advance affordable, domestic transportation fuels and technologies. In 2017, the Iowa General Assembly transferred the Iowa Energy Center from Iowa State University to IEDA. The Iowa Energy Center has a key focus area on alternative fuel and electric vehicles.

Highlights of key milestones from the past few years in relationship to electric vehicles:

- Iowa EV Market Study:** In 2016, the IEDA commissioned a study on electric vehicle charging to assess the current EV market, forecast future market conditions and evaluate programs and policies that could potentially help the market meet these projections. This study, titled Advancing Iowa's Electric Vehicle Market, provided analysis of the EV market in Iowa, its potential, and addressed educational needs identified by Iowa stakeholders.



- Iowa Energy Plan:** In 2016, this plan was developed through a partnership between IEDA and the Iowa DOT, chaired by then-Lieutenant Governor Kim Reynolds. It was a culmination of collaboration of stakeholders and included four foundational pillars, one of which was transportation and infrastructure. This pillar identified several strategies related to the expansion of electric vehicle infrastructure, which included planning for EV charging corridors, business model development and incentives for EV infrastructure. Progress on the plan, including updates on implementing electric vehicle strategies, can be found in the Iowa Energy Plan Progress Report released in 2018.



- Volkswagen Settlement Funding:** As a result of two related Volkswagen settlements, the state of Iowa is expected to receive approximately \$21 million in environmental mitigation trust funds over the next 10 years for projects that reduce emissions of nitrogen oxides. The state's required plan for the use of the funding, which has been accepted by the Trustee for the settlement, utilized input from the public to develop funding priorities. As of November 2018, Iowa is one of 41 states planning to spend 15 percent of the funding on EV infrastructure, which is the maximum allowable percentage under the settlement. The remaining amount is targeted at replacing older, medium and heavy-duty diesel vehicles with new clean vehicles, which may include electric vehicles along with associated charging infrastructure. The settlement funding is being administered by the Iowa DOT, with assistance from a state agency working group including IEDA, Iowa Department of Administrative Services, Iowa Department of Education, Iowa Department of Natural Resources, Iowa Department of Public Health, and Iowa Department of Justice. The first round of funding awards will be issued in 2019.

These state agency-led activities have been an effort to fulfill informational needs, identify some early state priorities and ensure Iowa isn't left behind while more consumers and businesses pursue electric vehicles.

However, Iowa's stakeholders have sought clarification on various state policies and procedures managed by the state that could impact the EV market. The potential for state agencies to be involved with electric vehicles and stations, based on existing purpose and duties, is discussed on the following page.



STATE AGENCY OR OFFICE	RELEVANT PURPOSE
Iowa Economic Development Authority / Iowa Energy Office	Coordinates implementation of Iowa Energy Plan, manages Clean Cities program focused on vehicles and fuels, houses Iowa Energy Center, administers funding programs, leads analysis of energy trends and opportunities in the state.
Iowa Department of Transportation	Monitors revenue into the Road Use Tax Fund, manages the collection of vehicle registration fees, regulates and manages signage for stations and services along the primary highway system, administers funding programs to reduce transportation emissions.
Iowa Utilities Board	Regulates electric rates and service of two investor-owned utilities. Municipal electric utilities and rural electric cooperatives are regulated primarily for service.
Iowa Office of Consumer Advocate	Reviews and investigates all aspects of regulated services provided to Iowa customers by electric utilities.
Iowa Department of Agriculture and Land Stewardship / Iowa Weights and Measures Bureau	Implements standards and conducts inspections for devices used to measure products for consumers, ranging from gas pumps to commercial scales.
Iowa Department of Revenue	Collects sales taxes from electricity and motor fuel taxes.
Iowa Department of Public Safety	Adopted National Electrical Code 2017 which has requirements on how to install electric vehicle charging stations. State inspectors would inspect in areas outside of local jurisdictions.

STRATEGIES TO SUPPORT ELECTRIC VEHICLE INFRASTRUCTURE

Three strategies to support the development of EV infrastructure in Iowa have been identified based on input of stakeholders and partners in the study, direction provided by the Iowa Energy Plan and research on strategies across the country. These strategies represent roles for both the private sector and public sector, including both the state and local jurisdictions. Most of the recommendations are aimed at supporting charging infrastructure as noted in the scope of the study; however, there are some cross-cutting strategies that address both vehicles and infrastructure.

CLARIFY AND UPDATE STATE POLICIES AND PROCEDURES

Iowa has initiated supportive efforts in the EV market, but many policies and associated procedures have not been updated or changed to address the subject. The types of decisions and actions undertaken by other states include studies and investigations, regulations, utility rate design, market development, financial incentives, and deployment of electric vehicles or infrastructure. This section focuses on how current policies and procedures of the state of Iowa are outdated in regards to EV charging stations and how progress can be made to support EV infrastructure.

Allow the Resale of Electricity for Vehicle Charging

Typically, electric vehicle charging occurs at the owner's residence or facility and electricity is purchased directly from the customer's utility. Charging stations serving the public must determine whether or how to recover the costs of electricity. In Iowa, no charging station utilizes a per kilowatt hour (kWh) fee for sales of electricity. The primary method of selling charging services is to charge a fee based on time at the station or parking spot. Some charging locations also structure pricing to avoid idling, which in this case is parking at the station after charging is over. Here are the primary examples of pricing structures that exist in Iowa:

- Many charging stations offer use of the station for free. Station owners such as employers or retail businesses may offer this as a benefit to the electric vehicle drivers. This is more common with Level 1 or Level 2 stations.
- Some metered public parking areas with EV stations charge by time spent in the parking spot.
- Tesla vehicle owners that take part in a paid Supercharger network access plan either have credits or make payments to Tesla that are structured with a variety of factors, including minutes spent at the station, the power available at the station, and an idle fee if applicable.⁴
- Electrify America pricing includes a session fee, a per minute charging cost and an idle fee of \$0.40/minute if applicable.⁵



A time-based fee structure is less transparent and equitable than a per kWh fee structure due to a variety of factors. These include:

- Recharging an EV battery is quickest when the battery is emptiest, and the rate of charging slows down as the battery fills.
- Weather can influence the rate of charge, especially cold temperatures. Recent research analyzed passenger electric vehicles using fast chargers and showed that when a battery was charged at 77 degrees, the battery might charge to 80 percent capacity in 30 minutes; but at 32 degrees, the battery's state of charge was 36 percent less after the same amount of time. Under the coldest conditions, the rate of charging was roughly three times slower than at warmer temperatures.⁶

Public utility regulation in the U.S. is often a joint state, federal and local framework. Federal regulations cover the interstate dimension of the energy market, but states also regulate the rates and service of public utilities through a public utility commission (PUC). Although the regulatory treatment of the resale of electricity varies from state to state, the key question is whether the resale of electricity by electric vehicle charging station owners to the public qualifies charging station owners as “public utilities” and therefore subject to regulation.

In states with public utility regulations similar to Iowa's, charging station owners commonly provide service for free or use a fee structure that does not incorporate a per kWh fee for electricity. A time-based fee still can be considered ambiguous over whether these stations could be considered to meet the definition of a public utility.

IEDA has identified 21 states that have implemented legal or policy changes to address the sale of electricity for vehicle charging or resale of electricity by non-utilities. Sometimes these changes have been the result of court cases. Other times, legislatures have amended public utility statutes or regulatory agencies have amended administrative rules. Occasionally, actions have been taken without changing statewide policy with circumstances being addressed on a case-by-case basis.

The key question is whether the resale of electricity by electric vehicle charging station owners to the public qualifies charging station owners as “public utilities” and therefore subject to regulation.



In states that have implemented some type of exemption from public utility regulation for electric vehicle charging, some locations still utilize a fee structure based on time while others implement a per kWh fee, in addition to other elements to a fee structure.

In Iowa, the legal definition of a “public utility” and the cases interpreting that definition raise significant questions about the regulatory treatment of electric vehicle charging. Currently, the Iowa Utilities Board (IUB) is considering these questions in regulatory proceedings and will determine the application of this definition to electric vehicle charging.

- Within Docket No. TF-2017-03057, industry petitions requested that IUB issue an order declaring that electric energy sold for the purpose of electric vehicle charging at commercial and/or public stations is not considered the resale of electric energy and that retailers may sell electric energy to the public for the purpose of electric vehicle charging by the kilowatt-hour.
- On August 27, 2018, IUB issued an order opening a rule making on electric vehicle infrastructure in Iowa, Docket No. RMU-2018-0100.⁸ IUB requested comments regarding potential administrative rules be filed by September 17, 2018, into RMU-2018-0100.
- On October 17, 2018, IUB conducted a public workshop regarding EV Infrastructure in Docket No. RMU-2018-0100. Stakeholders provided a variety of comments about electricity sold for vehicles in addition to other topics on EVs.
- On February 5, 2019, the IUB requested stakeholder comment on a potential rule change on electric vehicle charging at public facilities.

As described in IEDA's Advancing Iowa's Electric Vehicle Market report in 2016, clarifying state policy to specifically enable non-utilities to sell electricity for vehicle charging can help accelerate fast charging development, in addition to adding transparency and fairness in pricing. The report also indicated that the timeframe of considering this policy change should complement the pursuit of fast charging along highways.



In the two years since IEDA released the 2016 EV market report, interest in developing charging stations in Iowa has spiked. This interest arises from a variety of motivating factors, ranging from attracting EV drivers to spend money at an establishment to demonstrating an environmental commitment by offering this amenity. Regardless of the indirect benefits of hosting an EV station, it is difficult to foresee the EV charging market flourishing without the ability to establish and collect a fee based on the unit being sold. Allowing the resale of electricity for vehicle charging, especially by the kWh, will give businesses and consumers confidence in Iowa's ability to anchor a long-term market for electric vehicles. This will require updating state policy to clarify the ability of EV stations to sell electricity.

The near-term development of an electric vehicle charging policy can be pursued via different options:

1. Clarify in statute that an EV charging service provider is not a public utility, whether service is provided on a time basis, per kWh basis or another fee structure. This change could be addressed on its own or tied to specific circumstances.
2. Consider whether additional parameters should be included in the regulations implementing a potential statutory exemption. Aside from any needed legal clarifications, caution should be taken to avoid unintended consequences of making long-term decisions at an early stage in this market's development. Some optional parameters that other states have prescribed and/or Iowa stakeholders have identified include:
 - Specify which state agencies should have regulatory authority over charging stations.
 - Notification requirements to utilities regarding planned installation of a Level 2 or DC Fast Charging station.
3. If statutory changes are determined not to be necessary, implement more flexible regulations or changes to local utility service rules that provide the ability to resell electricity for charging without violating utility policy.
4. Acknowledge areas that need further research and examination by various state agencies and stakeholders in order to provide the best possible long-term framework for the electric vehicle market.

Stakeholder comments to IUB sought clarification and provided recommendations on a broader range of topics in addition to the resale of electricity. These comments, in addition to input during the IEDA study process, brought complex topics to light that merit further discussion in the future.



Enable Regulatory Oversight of Charging Stations

IEDA and other state agencies have been asked which agency or agencies, if any, would have any type of regulatory role regarding electric vehicle charging stations. Answering this question completely is challenging given the status of current laws and regulations, but the status of relevant agencies and how they might connect is what can be provided at this time.

The Iowa Department of Public Safety has overseen adoption of the National Electrical Code 2017, which has language about how to install EV charging and local jurisdictions have that to utilize in their permitting and inspection process. Areas outside of local jurisdictions would be inspected by state inspectors through Iowa Department of Public Safety. This represents a regulatory role already in place due to existing responsibilities with the National Electric Code that pertain to when the charging stations are installed, helping to ensure safe installation and operation of the stations.

The scope and type of consumer protection for electricity and motor fuels varies greatly, but there has not been much consideration to date for consumer protection regarding electric vehicle charging services in Iowa. This is not unlike most other states, as the market and technology are in early stages of growth and present a new type of transaction with consumers that is quickly changing and evolving. The two state entities that could potentially have an applicable role with this type of oversight would be the IUB and/or Iowa Weights and Measures Bureau at the Iowa Department of Agriculture and Land Stewardship.

The IUB regulates electricity under Iowa Code chapter 476. This includes regulation of public utilities. If EV charging stations are exempted from the definition of a public utility, the question becomes what, if any, authority will the IUB have over the stations. The IUB would retain its regulatory authority of utilities, which could potentially relate to future utility involvement in charging stations (e.g., ownership or investment), the delivery of electricity and potentially other matters.



There are a variety of proposals that other states' Public Utilities Commissions have received relating to EV charging stations. These are mostly focused on the investments and programs of utilities subject to state regulation and are provided to illustrate the variety of programs and proposals that have surfaced in other states through PUC processes.

- In Missouri, in response to a proposal by the utility Kansas City Power and Light to recover investments in charging stations, the Missouri Public Services Commission issued an order in August 2017 that it did not have jurisdiction over electric vehicle charging stations. A year later, a Missouri appeals court found that the Commission does have jurisdiction. The court's decision gave a path for utilities to propose including EV charging stations in their rate base which would be subject to the jurisdiction of the Commission.
- In Michigan, the state's two biggest utilities have filed programs to support electric vehicle charging. Consumers Energy filed a proposal with the Michigan Public Service Commission for a three-year pilot infrastructure program to support the EV market in their service territory. This proposal includes rebates for charging stations and a time-of-use electricity rate to encourage electric vehicle charging overnight. The utility has also conducted studies to demonstrate net benefits to the electric grid with their plan to avoid a scenario for other customers to subsidize EV charging. Another Michigan utility, DTE Energy, is also proposing to incentivize overnight charging between 11 p.m. and 6 a.m. to place downward pressure on rates, in addition to rebates for stations.
- As part of the utility Arizona Public Service's (APS) 2018 Demand-Side Management Plan, filed in September 2017 with the Arizona Corporation Commission, the utility proposed EV Pilot Programs. APS proposes to provide EV buses and charging infrastructure to selected school districts. It also proposes to establish a Managed EV Charging Pilot Program consisting of infrastructure owned and operated by the utility for commercial fleets, workplace charging, and stations at multi-family residential properties in partnership with the associated property management companies. The program will allow managed charging in a manner that avoids charging during peak hours, optimizes savings for customers and maximizes system efficiency. It will also help customers with limited annual budgets begin to electrify fleets or provide stations for employees or tenants.
- In California, Pacific Gas and Electric has submitted a proposal to the California Public Utilities Commission that would replace demand charges with a new subscription rate plan for customers that are using commercial EV charging, based on the power they need for their stations. Under the current rate structure, high-power stations can incur demand charges that are calculated based on peak electricity usage. This would be similar to a data plan for a cell phone bill and is intended to provide commercial customers with simpler, more consistent monthly costs that also account for their higher power needs.

Proposals such as the ones described above are subject to public comments. Ultimately, proposals are decided upon by commissioners appointed in each state, or local governing bodies for some utilities, considering factors that are unique to their state, utilities, and public interest. A variety of questions, concerns and legal perspectives exist on matters related to utility regulation, the role of utilities in electric vehicle charging stations, how to provide benefits to ratepayers and best protect consumers.

While Public Utility Commissions have a role in states with electricity regulation, Weights and Measures offices exist in the states with a role in motor fuel regulation. In Iowa, the mission of the Iowa Weights and Measures Bureau is to improve the accuracy of measurements, enhance consumer protection, promote fair competition, and facilitate economic growth and trade. For motor fuel stations, this includes licensing and inspecting gas pump meters and implementing national standards as developed through the National Institute of Standards and Technology (NIST) supported through the U.S. Department of Commerce.

NIST publishes handbooks for installers and station owners, developed through the National Conference of Weights and Measures (NCWM), to provide requirements for installation and testing as well as specifications on the method of sale to consumers. The state of Iowa adopts these handbooks as they are updated, either in sections or amended versions. This is provided through Iowa code and administrative rules.

NIST has tentative requirements for electric vehicle charging stations and the state could consider incorporating this into its Weights and Measures policies and procedures. These tentative requirements include, but are not limited to:

- Information that is required to be on the charging equipment's labeling about pricing, power level, and other details
- Measuring capabilities such as time and quantity of energy delivered
- Information required for a printed or electronic receipt
- Data storage and retrieval from charging equipment
- Accuracy tests
- Method of sale, which specifies units in terms of kWh and in addition, fees may be assessed for other services such as time or a fixed fee



State adoption and implementation of these requirements would be led by the Iowa Weights and Measures Bureau. These steps can be taken in consultation with policymakers and stakeholders:

1. Consult with the affected parties such as EV station owners/operators, other Iowa state agencies, and on a regional scale with neighboring states.
2. Examine the differences between liquid fuel sales and electric vehicle charging services and identify commonalities and differences for the regulatory approach.
3. Ensure administrative capacity at the state to extend regulatory oversight to EV charging stations.
4. Identify any necessary changes to administrative code or Iowa law that would be needed to provide regulatory authority to the Iowa Weights and Measures Bureau and adopt the NIST handbooks for EV stations.

Traditionally, the policies and procedures surrounding motor fuel and electricity have not had much, if any, synergy and correlation. Electricity as a motor fuel is a completely different paradigm, requires a new lens through which to view it and new strategies for adaptation.

Address EV-Related Shortfalls to the Road Use Tax Fund

Electric vehicles pay reduced amounts into the Road Use Tax Fund (RUTF) in comparison to vehicles that rely solely on taxed motor fuels. BEVs do not rely on taxed motor fuels to operate whereas PHEVs rely on taxed motor fuels when their electric charge is depleted. Based on 2018 data from the Iowa DOT, Iowa's fleet of BEVs and PHEVs were found to have resulted in lost RUTF collections of approximately \$317,000. This lost revenue would increase substantially with future growth of EVs in Iowa.



Fuel tax can't be fully recovered at public EV stations vehicles. Over 80 percent of light-duty passenger vehicle charging occurs overnight in residential settings.⁹ The electricity use of vehicles in these settings is often not tracked separately from their home and it is purchased directly from their utility.

Several other states have placed an annual fee on passenger vehicles through the state's existing vehicle registration system to recover lost revenue from fuel taxes. The annual fee approach alone can't fully recover lost revenue due to these reasons:

1. It would not capture revenue from out of state drivers using publicly available EV charging stations.
2. A flat annual fee for medium and heavy-duty commercial vehicles would not adequately represent their road use because the annual miles traveled varies significantly in comparison to passenger vehicles.

The Iowa DOT was tasked by the Iowa Legislature in House File 2256 with investigating potential funding mechanisms to mitigate any estimated decrease in future revenues in the RUTF related to increased usage of electric, hybrid and other high-efficiency vehicles. This report was completed in December 2018. It included hydrogen fuel cell vehicles and electric motorcycles, which are not covered in the scope of this study. The Iowa DOT report provided two recommendations for action related to EVs:

- An annual fee collected with registrations for all electric or plug-in hybrid electric vehicles. The recommended supplemental registration fee is \$130/year for all-electric vehicle and \$65/year for plug-in hybrid vehicles. Current Iowa Code would also ensure that these registration fees would be placed directly into the RUTF and have Iowa Constitutional protection that the funds can only be used for public road and bridge improvement and maintenance.
- A per kWh excise tax for charging at non-residential locations. The recommended tax is \$0.026 per kWh. This tax mimics the current excise taxes levied upon liquid motor fuels and is subject to the Iowa Constitutional requirement that the revenue be used for Iowa's public roadway system.
 - Because commercial electricity use in Iowa is already subject to Iowa sales tax, electricity for use at charging stations should be exempted from sales tax. This process of obtaining a sales tax exemption and implementing an excise tax is like the implementation of Iowa's new Water Service Excise Tax, passed in 2018 as part of Senate File 512. This also would result in electricity used by a consumer for charging being subject to only a single tax in Iowa, thereby improving the feasibility of fast charging stations and the cost to consumers. It would also eliminate the question of whether sales tax on electricity could be paid more than once, by the station owner and also by the consumer.



The annual fee and per kWh fee were both calculated to mitigate losses to the RUTF in the most equitable manner possible, accounting for the efficiencies, fuel economy of vehicles and how energy use correlates to road use. The Iowa DOT report recommends implementing the supplemental registration fee to take effect on January 1, 2020 while giving additional time for the per kWh excise tax to take effect on July 1, 2020. The per kWh fee is a unique strategy that has not been widely implemented in other states and will require time and in some cases costs for charging station owners to adapt.

- Some stations do not separate the electricity use for vehicles from other equipment or a facility. This would be more likely with some Level 2 stations, especially those that are not capable of monitoring individual charging session usage.
- For stations owned and operated by government entities, electricity use for their fleet vehicles would not be subject to excise tax because it would still be considered a motor fuel. If stations are also used by non-government owned vehicles, such as employees or the general public, those would be subject to excise tax. It would be not be advantageous to intermingle the use of those stations.
- When stations use different approaches for their price structure and are not solely tied to a per unit (or per kWh) basis, a new fee per kWh tax could require new approaches for tracking this information.

The implementation of the Iowa DOT's recommendations is seen as a 10 to 20-year solution toward mitigating losses to the RUTF. At some point in the future, collecting transportation revenues could be based on miles traveled, commonly called a mileage-based user fee. With this approach, alternative fuel technology and fuel efficiency would no longer pose a risk to transportation revenues. This would need to be initiated at a national level to most effectively address miles driven in Iowa by out-of-state passenger vehicles. Additionally, the advantages and disadvantages to the optional approaches to collect the data would need to be thoroughly evaluated.

It is timely and critical to begin mitigating losses to the RUTF due to electric vehicles. By not doing so, the growth of EV travel could have a negative impact on the maintenance of public roadways at both the state and local levels. Local government leaders are very aware and sensitive to the needs for this revenue and addressing this shortfall can help them more readily embrace and encourage electric vehicle growth and travel in their communities.

ADVANCE PLANNING AND DEVELOPMENT OF CHARGING STATIONS

Growth of electric vehicle infrastructure in Iowa has been supported by businesses, communities and utilities that have provided necessary leadership to serve this growing demand and advance the EV market. Development of this infrastructure throughout the state will continue to benefit from thoughtful planning and coordination by equipment providers, property owners, installers, local jurisdictions and utilities. There will continue to be a need for new stations at locations such as workplaces, parking garages, multi-unit residential buildings, retail establishments, and tourist attractions. Removing barriers to station development and creating a supportive local policy and regulatory framework will have long-term benefits. There are unique needs and challenges associated with planning and developing fast charging stations and corridors to enable longer-distance travel. These will require public-private partnerships, innovative strategies, and dialogue with other states.

Removing barriers to station development and creating a supportive local policy and regulatory framework will have long-term benefits.

Improve Local Codes and Permitting

Existing policies and procedures undertaken by cities and counties can be utilized and modernized to provide a supportive framework for charging station development.

Local zoning, parking, and building codes and inspections offer opportunities to encourage station development and reduce potential implementation barriers. For example, new building stock and parking lots can be encouraged through incentives or required through EV-ready building codes to provide the necessary electrical capacity and pre-wiring to make it possible to install EV stations in the future.

Local electrical permitting and inspection processes can be streamlined and/or clarified to provide unique consideration to charging station projects. Some third-party fast charging station developers may avoid certain sites solely due to anticipated challenges in the local permitting processes. Training and education for inspectors in addition to streamlining the ease of permitting can reduce time, cost and inconvenience in this process for installers and charging station owners.



Local electrical permitting processes could be also be tool to help utilities with their electrical load-planning activities if information on charging stations could be provided to utilities. The lack of information is more of an issue for charging stations not open to the public, such as at a residence or workplace, because the stations will not appear on public station locators online. One possible strategy on this type of information sharing was explored in the Electrify Heartland initiative, based in the Kansas City region.

- An electrical permit form could include a statement acknowledging the system owner agrees to release limited information about the system to the applicable public utility to be used solely for the purposes of gauging the sufficiency and efficiency of the utilities generation, transmission and distribution services.
- If an online application process has been adopted, such process should either allow the utilities to access relevant information about the permits that have been granted or include a notification process to send the relevant information directly to the utility.

The Iowa Clean Cities Coalition, housed at IEDA, can be an educational resource and facilitator for local governments, utilities and code officials on these issues through three key approaches.

- Emphasize the National Electrical Code of 2017 for its guidance with EV station development and explore training needs for local implementation.
- Identify model policies that promote cost-effective, EV ready developments and work with interested stakeholders to advance them.
- Explore utilization of local electrical permitting processes to track EV stations or EV ready developments, particularly in communities with more growth in EVs.

Making the built environment ready for electric vehicles and ensuring that local permitting processes are constructive and not overly prohibitive will help lay the foundation at the local level for EV infrastructure support.



Support Fast Charging Station Feasibility and Profitability

There are many different potential business models for EV charging stations, and which model will work best in each location will depend heavily on certain factors such as demand, the partners involved, the capital available, the income/return on investment expectations, local electricity regulations, price of electricity and the anticipated utilization.

In comparison to Level 2 chargers, fast charging stations are impacted by the widest range of potentially challenging variables, especially with the high up-front cost of stations, installation and potential utility upgrades. It is essential for charging station owners to coordinate with the local electric utility early in the planning phase to better understand the location and utility-specific factors associated with developing a station. This can help establish reasonable expectations on cost and site-specific needs.

Financial assistance with covering up-front costs can greatly improve the financial outcomes for station owners and operators. The State of Iowa has assisted with up-front costs for biofuels infrastructure for many years through the Renewable Fuels Infrastructure Program, which can give retailers assistance with the cost of adding ethanol dispensers and tanks to their business. Iowa's successes in the availability of ethanol are a result of effective public-private partnerships and a supportive policy framework. While the state may not be able to provide the same scale of support to electric charging stations, examining investment options can help prepare the state to serve its citizens, visitors and potential residents who prefer to drive an electric vehicle.

There are a variety of investment options and partners that can help improve the business case for fast charging in Iowa. The state and interested stakeholders can help pursue various sources of capital investments and partners to support EV infrastructure.

- Work with companies set up to own and operate charging stations in multiple states or nationally, as is the case with Tesla, Electrify America, and others that expand their footprint of stations in the Midwest. These types of partnerships can help Iowa businesses reap the benefits of increased visitors, foot traffic and customers without the responsibilities and expertise needed for owning and operating a station.
- Utilize the limited funding that is available through the state's allocation of the Volkswagen settlement to develop charging stations. This funding should be part of a broader strategy by its recipients to provide EV charging through a sustainable business model, with necessary partners and planning evident at the time of application.
- Encourage pilot projects that utilize energy storage on-site to minimize power costs for the station operator and reduce peak loads on the grid.



- Consider how utility investments and incentives could assist in the growth of electric vehicle stations while also creating a positive climate for non-utility business investment in stations. These could come through a variety of forms, such as utility ownership of stations, incentives for station development, expanding distribution infrastructure where capacity is needed, and supplying power to a point where a station might be installed. Utilities would also be well-suited to help fulfill needs in unique markets. Allowing, but not requiring, utilities to own charging stations is recommended.

Regardless of where the investments in stations can come from, allowing for a variety of business models to innovate in this early stage of the market can help provide the infrastructure support to serve electric vehicles in Iowa.

The costs associated with operating fast charging stations also plays a large part in determining the return on investment and financial sustainability. Some factors, like ongoing maintenance costs and utility rates, will vary at each location and may depend on the type of charger. A high utilization rate is universally important so that station owners can earn enough revenue to support a profitable business case and justify the investment. Achieving high utilization can be aided by strategically assisting with corridor development and supporting longer distance electric vehicle travel.



Plan and Develop Electric Charging Corridors

Taking longer trips with electric vehicles requires drivers to assess where they can recharge, if at all, along their route. The availability of fast charging stations along travel corridors will become a defining characteristic impacting whether consumers will purchase EVs, where they will travel, and which states are going to best attract EV drivers as tourists and future residents.

The Iowa Energy Plan supported planning for electric vehicle charging corridors and identified potential locations for these stations along Interstates 80, 35, 29 and 380 along heavily traveled routes. Stakeholders have conveyed support for looking at how other highways, in addition to the interstate system, can be part of the plan for charging corridors. IEDA has identified interested property owners and businesses, communicated with charging companies, and participated in regional planning processes to advance charging corridors.

Electric vehicles provide a variety of benefits to Iowans, including reduced emissions, energy-efficient and cost-efficient transportation, use of the state's growing renewable energy from the electrical grid and steady fuel prices.

The U.S. Federal Highway Administration (FHWA) selected Interstates 35 and 80 through Iowa as Alternative Fuel Corridors due to the planning and partnerships in place to expand infrastructure for alternative fuels, including electric vehicles. This has helped to elevate the dialogue with other states and stakeholders about electric vehicle travel throughout the Midwest and how to best enable it.

When developing a charging corridor, the suitability of certain sites to host fast charging stations must be considered. Suitability of sites can be impacted by a variety of factors:

- Distance in between stations along a route
- The availability of three-phase power or cost of upgrades
- Amenities available to drivers while they charge such as food, shops, wireless internet, and restrooms that could potentially be available on a 24-hour basis
- Financial resources available for up-front capital, in addition to operating and maintenance costs
- Potential usage by local EV drivers, taking into account traffic volumes and regional electric vehicle concentrations

Developing charging corridors serves a broader public purpose than the interest of a single geographic area or station host. As such, various states and stakeholders have collaborated to try and overcome common barriers, derive lessons learned and consider what synergies may exist.

- The West Coast Electric Highway is an extensive network of DC Fast Charging stations along a few key roadways in California, Oregon, Washington and British Columbia. The initiative is a collection of projects, funding sources and partners with the same vision – to provide a network of fast charging stations enabling electric vehicle drivers to make longer trips between cities. Each state has an office tasked with leading their part of the initiative. This fully developed series of stations can be marketed together, increasing awareness and alleviating range anxiety.



- The governors of Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming signed a memorandum of understanding (MOU) to provide a framework called the REV West Plan for creating a regional electric vehicle plan for the West. The plan identified more than 5,000 miles of major highway corridors to be the focus of its efforts. The MOU also established a coordination group tasked with specific tasks and will meet on a quarterly basis. In the fall of 2018, a working group comprised of members from these states issued a request for information to seek input on what factors states should consider when developing voluntary minimum standards for DC fast charger installations.
- Several non-profit and utility groups, identifying themselves as the Missouri EV Collaborative, created a proposal for statewide highway corridor DC fast charging. It outlined specifications for a minimum practical network of “proposed charging islands” including, but not limited to, spacing at 25-75 miles, number and type of ports available for EVs to plug in, being near interstates or multilane highways, and in communities greater than 2,000 in population. The proposal utilized DOT traffic maps to prioritize locations and provided three levels of priorities based on traffic counts:
 - Priority 1 being along interstates
 - Priority 2 along multi-lane highways having more than 10,000 vehicles/day
 - Priority 3 along multi-lane highways having fewer than 10,000 vehicles/dayThe proposal utilized this framework and concluded approximately 40 charging islands were needed with a total development cost of \$6.8 - \$14.4 million, citing key factors that will impact costs.
- The Michigan Energy Office commissioned a study to produce scenarios for EV station placement and investment along highways. Conducted by researchers at Michigan State University with input from various stakeholders, the study evaluated the feasibility of a road trip, the distance between stations, the charging speed, time needed to get a charge, wait time for chargers and detour times added to a trip. It also looked at low-tech and high-tech scenarios, representing different sizes of vehicle batteries and power output levels of chargers.

Some stations are likely to be developed regardless of the direction that corridor planning provides. The state of Iowa's approach should balance free market principles and provide assistance with making informed decisions and long-term considerations for a sustainable network for travel. The following activities can help shape development of charging corridors in Iowa:

- Explore the feasibility and usefulness of a detailed statewide EV corridor plan.
- Encourage collaboration and planning between stakeholders to fill gaps in the fast charging network while emphasizing the most suitable sites.
- Monitor information on regional electric vehicle travel, traffic volumes, proximity to potential Iowa EV drivers, and existing/planned fast charging stations.

- Ensure that stations can provide adequate signage along interstates, similar to what motorists are accustomed to seeing for gas and diesel availability at interstate exits. National guidance exists for state DOTs in the Manual for Uniform Traffic Control Devices to consider adopting or modifying signage to meet state priorities.
- Work with other states to examine cross-cutting issues such as station spacing, regulatory trends and options, policies and lessons learned. Support the formation of some type of a Midwest states electric vehicle travel consortium that communicates regularly and considers collaborative opportunities.

MAXIMIZE BENEFITS FOR CONSUMERS

Electric vehicles provide a variety of benefits to Iowans, including reduced emissions, energy-efficient and cost-efficient transportation, use of the state's growing renewable energy from the electrical grid and steady fuel prices. Expansion of electric vehicle infrastructure can have a variety of positive impacts, not just to drivers of electric vehicles but other consumers, businesses and ratepayers. The policies, planning and implementation approach utilized by policymakers, regulators, utilities, industry and others will define the outcomes.

Plan for Additional Electricity Demand

In the near term, the impacts of EV charging on the utility grid is relatively small. As EV adoption grows, the added demand for electricity will impact utility planning and distribution infrastructure buildout, which has an impact on all customers.

- In a residential setting, if there is a neighborhood where many EVs are acquired and are subsequently charged simultaneously, the distribution system in that area must be able to handle that increase in demand.
- In commercial settings, fast charging stations have an especially significant power draw from the grid. Although most vehicles today only charge at 50 kilowatts (kW), fast charging stations of the future will have significant power needs. For example, a station that has six 150 kW or two 450 kW chargers would be able to generate a power draw, while EVs are charging, that is equivalent to the power demand of a large high-rise office building.¹⁰
- In the heavy-duty vehicle market, such as electric school buses, transit buses or semi-trucks, the demand at the fleet domicile location would increase significantly. These vehicles may have limited flexibility on when they can charge due to their duty cycle. Some commercial vehicles such as semi-trucks could need publicly available fast charging stations along a route. Early industry estimates indicate that roughly 1.6 megawatts (MW) of charging would be required at a location for an all-electric semi truck. This could result in unique strategies to plan for and manage that demand. For school buses that are parked during peak hours of the day, vehicle-to-grid and managed charging strategies could utilize the actual buses as energy storage as needed and providing grid benefits.



In all these situations, notifying the local utility early on in a project will help ensure that utilities can adequately plan for increased demand on the grid and any potentially necessary improvements if needed. The impact of charging infrastructure investment on electricity rates is a key concern of utilities, regulators, advocates, and customers. By estimating the additional demand on utility grids, measures can be employed to reduce the overall impact on the cost of service. Properly planned and managed, this added load on the system can improve overall utilization of the system.

Incentivize Charging at Beneficial Times

The impact that EV charging has on electricity markets and utility infrastructure depends heavily on when the charging occurs. If an electric vehicle is charging in a peak timeframe when other electrical use is at its peak, this can place additional demand on the grid. For example, many people arrive home from work and use a lot of electricity such as for appliances, television, lights, etc. around 6 p.m. If an electric vehicle owner begins charging immediately upon return from home, this further increases their peak load. Delaying charging until off-peak times, which may vary depending on the location but generally between 9 - 11 p.m., provides a variety of benefits.

For the grid, charging is optimal when there is a surplus of energy available. In Iowa, this corresponds to nighttime, when there is an increased availability of wind energy, enabling EV owners to reduce charging from fossil fuel-generated electricity. In a location which has excess solar resources, charging could be targeted to daytime hours to align with the output of that resource. In most instances, charging overnight for most of an electric vehicle's energy needs results in a more efficient use of the grid to reduce long-term costs and maximize utilization of wind energy. Several optional strategies can be implemented that maximize benefits from charging at off-peak times.

Solutions may be specific to utility service area characteristics.

- Most EVs have an optional setting that allows drivers to delay when charging begins, either based on the preferred timeframe for charging or the time the EV driver needs to leave each morning. Educational initiatives for consumers could help increase this voluntary behavior.
- Time of Use (TOU) rates, which allow customers to shift usage to lower peak times and save money, have been utilized by some utilities longer than the recent growth of EVs. Incentivizing off-peak use through a TOU rate shifts the utilities' demand away from periods of peak demand, easing the need for expensive infrastructure upgrades. These programs are often structured to take the property's entire electricity use into account. In these instances, a full analysis of individual demand and usage would be needed to determine if the customer would ultimately save money, especially if the program charges higher-than-normal rates for electricity used during peak hours.
- A TOU rate can be specific to EV charging and not the entire property. This could entail installation of a separate meter for the vehicle than the rest of the property. Early pilot programs have demonstrated that EV-only TOU rates result in lower electricity bills for customers.

- A more advanced technological approach, commonly referred to as smart charging or managed charging, involves use of a charger that is networked and capable of bi-directional communications with the grid. Managed charging allows a utility or third-party to remotely control vehicle charging by turning it up, down, or even off to better correspond to the needs of the grid. This technology is commercially available today. Investments could prioritize charging equipment capable of smart or managed charging, even if the program isn't in place yet, so that grid benefits can be realized as EV penetration increases.
- Programs can be offered to provide rewards in exchange for off-peak or managed charging. This type of program can utilize various technology options for a utility to track participating customer charging habits and provide monthly rewards. This avoids the cost associated with the purchase and installation of a second meter.

Whether it is a vehicle for personal or commercial use, charging at the domiciled location will often be the predominant choice. TOU strategies can help lower costs for all consumers and rate-payers by making an efficient use of the grid while at the same time giving the EV owner more affordable, and often more environmentally friendly charging options. When an EV driver must charge at a publicly available station, the experience and costs can be quite different, depending on the approach used to build out the network of publicly available charging stations.



Enhance Consumer Access and Usage at EV Stations

Charging stations across the country have been developed in a bottom-up fashion through the independent efforts of numerous organizations. Infrastructure has not been designed in a top-down fashion and was not originally planned for interoperability, which is the ability of systems such as software within vehicles or charging stations to interact and exchange information with other systems to enhance the user experience.



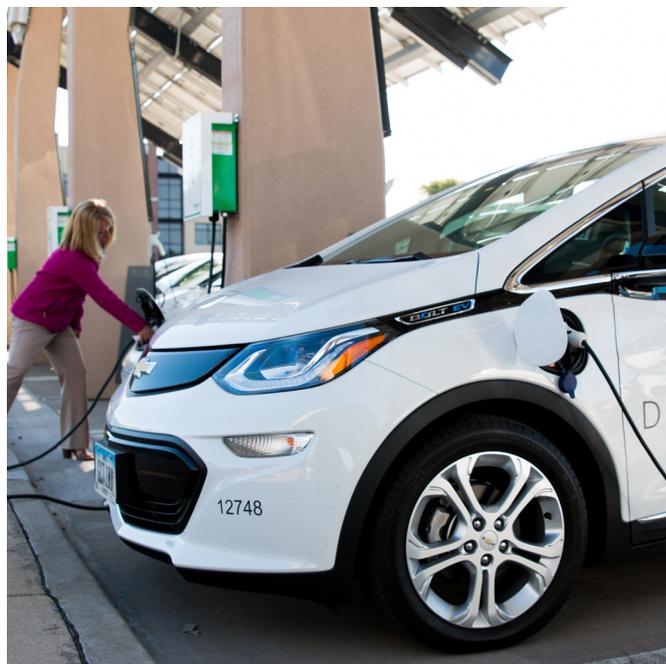
EV drivers can typically find networked charging locations, along with information about applicable fees and the number of charging ports, in smartphone apps and websites. For networked chargers, discussed earlier in this report, two distinct types of access are possible:

- **Subscription-only:** Users subscribe to the service network, which typically requires an initial deposit and periodic deposits to keep a payment account active. Users then connect their vehicles and use a dedicated RFID card or smart phone app to initiate a charging session and complete an electronic payment transaction.
- **Open access:** These service networks can provide a dedicated subscription, but also accept universal payment methods. However, many networked stations utilize an RFID card, mobile app or 800 number to accept payment and do not have a card reader.

EV drivers who mainly commute over the same routes can work out a reliable payment solution that meets their needs. Traveling longer distances and roaming across networks can be difficult for drivers due to a patchwork of methods to pay for charging a vehicle. People don't always want to carry around various payment cards or install multiple apps for the different networks. Becoming competitive with the convenience of buying liquid fuel will require some integration planning for EV chargers.

Open standards facilitate a seamless driver experience, minimize infrastructure investment risks and allow for the efficient integration of EVs into the electric grid.

Open standards facilitate a seamless driver experience, minimize infrastructure investment risks and allow for the efficient integration of EVs into the electric grid. The Open Charge Point Protocol is a leading example of an internationally established application protocol for communication between electric vehicle charging stations and a central management system, also known as a charging station network, and helps facilitate communication and data transfer. This enables site hosts to switch charging station networks or equipment without having to switch both. Using another consumer product analogy, a television still works if the consumer switches a satellite or cable service provider, and vice versa. OCPP enables mixing and matching interoperable hardware and software. This is a voluntary protocol with limits on compliance and verification, but it could be encouraged as part of an investment or incentive strategy.



The EV station industry has enabled a variety of pricing approaches to suit site hosts' priorities. The combination of charging and parking services associated with EV charging infrastructure is uniquely different than a liquid fueling station. Flexible pricing can help advance a business model that is advantageous, as well as fostering competition and encouraging certain charging behaviors, but it can also create an unpredictable experience for EV drivers.

- Fixed rates, hourly rate, length of stay or time of day pricing
- Free charging for a period of time followed by a fee to encourage moving a vehicle
- Flat session fee followed by another rate
- Different classifications of drivers (e.g., employees versus visitors)
- Minimum and maximum fee per session

Other than policy changes to allow resale of electricity as discussed previously, states have not weighed in much on the actual pricing or its mechanisms at EV stations. At an early stage in the EV market, variety and flexibility may adequately suit EVs as a niche market of consumers eager and able to stay informed on trends and options for charging available. Convenience and consistency for the driver's experience could play a factor in future EV adoption, for those who are not early-adopters, or where drivers travel based on charging options.

At a minimum, making EV stations subject to state Weights and Measures oversight can provide a baseline of reliable and consistent standards that are based on nationally-recognized guidance. Programs that approve incentives to EV stations, such as the Volkswagen settlement, can encourage open access stations, transparent displays of pricing with universal payment methods accepted, and open standards to help make EV charging as accessible as possible for consumers.



Electrify Transportation Choices Across Iowa

Personal transportation using an electric vehicle has primarily been possible for individuals who have been able to afford the increased cost for lease or purchase. Although costs have been reduced through availability of a federal tax credit, it has still been more expensive to acquire an electric vehicle. Used electric vehicles are becoming more affordable, but availability is limited.

The largest contributor to incremental purchase costs for PEVs compared to gasoline vehicles for consumers is the cost of batteries. Back in 2010, average battery pack prices were \$1,000/kWh. At the end of 2017, average prices hit a low of \$209/kWh, a 79 percent drop in seven years.¹¹ Forecasts provide that starting in 2024, the upfront cost of EVs will become competitive on an unsubsidized basis. By 2029, predictions are that most EVs will reach parity with internal combustion engine vehicles. If these forecasts come to fruition, EVs will be within reach for more consumers at varying income levels in the next decade.

Providing electric transportation for a broad cross-section of the Iowa population can include a variety of options.

- Electric transit buses are a fast-growing segment of the electric vehicle industry nationally and around the world. The total cost of ownership for electric transit buses, which includes both up-front and operating costs, is competing faster with conventional buses than light duty EVs are to its counterparts. They can also help reduce emissions in congested areas and make electrified transportation an option for people of all income levels. In addition to larger transit buses common to urban areas, smaller shuttle buses and vans are becoming available which can increasingly serve rural communities.
- Electric school buses are attracting interest from school officials as well as environmental and health advocates. Utilities are also interested in the battery storage capabilities of the buses during the summer when they are not in use and can provide grid reliability benefits.
- Providing charging at multi-unit dwellings provides an important opportunity to consumers residing in townhomes, condominiums, and apartments, who may not have access to a home charger or outlet every evening. This can be provided as an amenity to help attract tenants who want that option and improve availability of workforce housing. A few states have passed laws that allow tenants to install EV charging on leased premises, with certain requirements of the tenant and options for the landlord.
- Ridesharing services and car sharing are especially being embraced by the millennial generation, which is moving away from car ownership, especially in big cities with a higher cost of living or on university campuses. Low income areas can also benefit from ride or car sharing services for transportation. A variety of companies, including automakers, are investing in these enterprises, including a move to EVs. Electric vehicles in these applications can lower operational costs for users. Many ridesharing vehicles drive more than the average personal car; therefore, emissions have an even bigger impact.



CONCLUSION

The state of Iowa has been a leader in embracing new opportunities in clean energy technology to benefit its residents, economy and the environment. Renewable energy production continues to grow while more citizens, businesses and visitors desire to power their vehicles sustainably. This report captures some near-term solutions and needs that translate to long-term impacts of this growing market.

As technology continues to evolve, more challenges and opportunities will present themselves, and the state should remain responsive to enable the best possible outcome. Within a couple of years, heavy duty electric semi-trucks are anticipated to be commercially available, on Iowa's roadways and plugged into the electric grid. The costs of batteries and energy storage are declining, and this could considerably improve the feasibility of fast charging stations and utilization of the grid.

Iowa's support for electric vehicle charging stations should be forward thinking and adapt to consumer and market trends. This includes fostering competition in the marketplace and improving access for consumers. Policy and regulatory solutions, collaboration from businesses and communities, and active utility partners will all be necessary to maximize the benefits to the state.



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